

VERIFICATION AND REVIEW OF THE HYDROGRAPHIC SURVEY

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Verification and review of a hydrographic survey represent the third of four principal operations in the construction of a nautical chart. The field work, resulting in the boat sheet and sounding volumes, and the smooth sheet, generally plotted immediately after the close of the field season by the hydrographer or under his supervision, are the first and second steps, and the compilation of the chart manuscript the fourth and final operation. As used in this paper, the term hydrographic survey includes the band of topography of varying widths adjacent to the shoreline. It has always been the practice, however, in the Coast and Geodetic Survey, to survey the two separately, combining them partially on the smooth sheet and more fully on the nautical chart.

Verification of a hydrographic survey has for its primary purpose a careful checking of the office work performed in the field. Secondly, its purpose is to correlate the survey with other contemporary surveys of the Coast and Geodetic Survey and to ink the survey as a complete and accurate record of all hydrographic information currently obtained in the area.

The smooth sheet is submitted to the Washington Office with all hydrographic data — soundings, depth curves, notes and kelp symbols — in pencil. The topographic detail, including shoreline and alongshore installations, bare and awash rocks, signals, landmarks, and the like, is invariably inked in the field. The accompanying records are complete in that all corrections for tide and sounding apparatus are entered and checked and the true depths computed and checked. If the survey is controlled by electronic methods, observed distances are reduced to true distances and the results checked. Although a standard procedure is followed in verification, each survey, or group of adjoining surveys, has aspects which are unique to the individual survey or area covered. The advent of electronic methods of hydrographic surveying, while greatly expediting the field work, has added considerably to the problems of the verifier. Interpreting the fathogram record in areas where the bottom is covered with a mantle of marine growth is probably the most difficult problem with which the verifier is confronted in determining true depths. Dense kelp reflects a sound echo which occasionally blots out the graphic record of the bottom profile. Then, too, other recordings caused by side echoes in rapidly changing depths, by fish or transient submerged objects, must be properly interpreted. Also, the irregular graphic profile caused by surveying in a choppy sea is not too unlike the profile of sand waves on the bottom.

As the verification of a survey progresses, each sounding or other hydrographic feature is inked for permanent record. This is a simple operation in open areas, but considerable care and judgment must be used in congested areas where numerous overlapping sounding lines are run to develop channels, shoals, reefs,

and irregular features. Not all of the soundings are inked in such areas; a judicious selection is made in order to present a simple and clear delineation of the submarine relief. Channel limits, controlling depths, and the least depths on reefs, are clearly represented on the survey sheet so as to be easily read on a photographic copy.

During the process of inking, the positions of all least depths on shoals or banks and of all critical soundings are replotted from the original records, as well as positions which appear to be erroneously plotted. In all, from 5 to 10 percent of the positions are check-plotted during the verification.

Depth curves are next drawn. These curves serve a two-fold purpose. From the viewpoint of navigation, they help bring into prominence bottom features which the navigator, equipped with an echo sounder, can use in position fixing. Cartographically, they serve as a check on the accuracy of the survey, since any inharmonious sounding line, area, or junction with an adjacent survey is immediately brought to light by an unnatural shape or form of a depth curve.

In drawing the curves, cartographic license is permitted, within limits, in order that bottom features will be represented in a natural and simplified manner. Frequently, temporary auxiliary curves are drawn to assist in the proper delineation of a submarine feature.

To complete the hydrographic survey, data must be applied from the contemporary topographic survey. Most such surveys are now obtained by air photographic methods. In harbor areas and along rocky coasts, air photographic surveys furnish an abundance of hydrographic detail. Inconsistencies between the two surveys occur occasionally because of inadequate interpretation or inspection of isolated offshore features appearing on the photographs. If the air photographic survey has been compiled and field-inspected in advance of or during hydrographic operations, any conflicts between the two surveys are resolved in the field. Otherwise, conflicting information is evaluated and resolved in the office. Adequate field inspection of the photographs and proper consideration of tide level and tidal range are necessary in order to satisfy navigational requirements.

The verified survey is next reviewed. This extends the correlated contemporary record into the past and more broadly into the future. The reviewer considers the survey in its broader aspects insofar as its application to the chart is concerned. For proper evaluation of the survey, the reviewer must be familiar with bottom conditions in the area, whether stable, steadily changing, or subject to violent change. He must be thoroughly familiar with present-day methods of hydrographic surveying and with accuracies attainable, but he must appreciate the limitations of all prior methods of sounding and position determination, such as pressure tubes, early-day echo sounding, and radio acoustic ranging.

The reviewer inspects generally the various phases of office work done by the verifier and examines critically any changes the verifier may have made in the original field plotting.

The most important phase of the review is the comparison with all prior surveys in the area. In unstable bottom, as many as 25 prior surveys may have to be examined, some of which were made over 100 years ago. Each prior survey is compared with the present survey to ensure that the earlier survey may be superseded for charting purposes. Important data on the early surveys, not disproved by the new survey, are brought forward to the new survey in colored ink.

In areas of stable, irregular bottom, the reviewer is particularly cautious in his evaluation of old data. The age of a survey does not necessarily spell obsolescence. Many detached reefs were discovered by the early hydrographers on widely spaced sounding lines that occasionally are missed by the modern surveyor even with more intensive coverage.

Before a decision is made to retain old data, however, its authority is verified from the original sounding volumes, where it is occasionally found that an incorrect shore signal was used, the fix improperly plotted, or an arithmetical error made in reducing the sounding. Barring such errors, no critical depth on a prior survey in an area of stable bottom is ever rejected, unless conclusively disproved by the new survey.

Another phase of the review work is the comparison of the new survey with the largest scale chart of the area. The nautical charts of the Coast and Geodetic Survey, while based primarily on surveys made by its own field parties, frequently contain information received from other governmental agencies and from miscellaneous sources, such as mariners, yachtsmen, fishermen, and harbor authorities. The object of these comparisons is to detect conflicting data and resolve inconsistencies.

The final stage of the review work is the preparation of a report on the survey for administrative approval. This report becomes a permanent part of the record of the survey and contains statements on the adequacy of the survey for charting and other purposes; compliance with project instructions; differences in depths at crossings; completeness with which depth curves could be drawn; suitability of the junctions with prior and contemporary surveys and recommendations for additional work if the hydrographic coverage is not considered complete. As the reviewer has had broad experience with many types of surveys the review frequently contains suggestions for improvements in field or office methods.

The nautical chart is a culmination of geodetic, hydrographic and cartographic endeavor. When the consequences of a ship disaster accompanied by possible loss of life and property are fully realized, the seriousness of the responsibility of the reviewer in his evaluation of the surveys and their component data is obvious, and equal, perhaps, to that of the hydrographer.
